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Report, drawn up by Samuel Hunter Christie, Esq. M.A., F.R.S., on Mr. Faraday's paper, entitled "Experimental Researches in Electricity:—Third Series."

Report.

§ VII. *Identity of Electricities from different Sources.*

§ VIII. *Relation, by measure, of Common and Voltaic Electricity.*"

In order to prove the identity of electricities derived from different sources, the author in this communication, after viewing the phenomena exhibited by electricity, shows, that although some effects are most readily derived from a particular source, yet none are peculiar to such source. The principal points in which ordinary and voltaic electricity have been considered to differ, are the inefficiency of ordinary electricity to produce chemical decomposition, or to affect a magnetic needle like voltaic electricity. The experiments of Wollaston were made early in the application of electricity to chemical decomposition, before the general law of the transfer of the elements to the poles of the battery had been indicated; yet his 4th experiment, in which electricity from the machine was passed through a solution of sulphate of copper, and his 5th, where it was passed through a solution of corrosive sublimate, have the true characteristic of decomposition by voltaic electricity: and it is surprising that those who advocate a distinction between these electricities should have ventured to overlook these experiments, when they bring forward the experiment of the decomposition of water, as deficient in this characteristic of the transfer of the elements *. This circumstance, however, induced Mr. Faraday not merely to repeat Wollaston's 4th experiment, which he did with complete success, but to adopt different arrangements; and by these, with ordinary electricity, he obtained, in various instances, chemical decompositions having all the characters of decomposition by voltaic electricity. Whatever doubt, therefore, may have been thrown upon this part of the subject, he has entirely removed it.

The author has also removed the doubts which it appears had been entertained respecting the conclusion of M. Colladon, in consequence of the failure of his experiments in the hands of others. By a particular arrangement connected with the glass inclosing the galvanometer, and by retarding the passage of the electricity through its wires, by means similar to those by which gunpowder is most successfully

* Phil. Trans. 1832, p. 282, note.

exploded by an electric discharge *, which he also employed to effect chemical decomposition, Mr. Faraday succeeded in causing the needle to deviate, both by the discharge of a battery, and by electricity passing directly from the conductor of the machine. In justice to M. Colladon, we must remark, that the account which he gives of his experiments affords no reasonable ground for doubting the accuracy of his conclusions : the details are clear, and the numerous results unequivocal †. We may also notice, that, in the same memoir, M. Colladon gives an account of some very interesting experiments, made with a similar arrangement, on the magnetical effects of atmospherical electricity, by which its power of causing deviations of the needle is satisfactorily established.

Mr. Faraday, in the comparison which he makes between the effects produced by ordinary and by voltaic electricity, shows that the following, though differing in degree, are common to both, viz. attraction and repulsion, evolution of heat, magnetism, chemical decomposition, physiological phenomena, the spark. To these proofs of the identity of the electricities from these sources may be added, that batteries have been charged from the voltaic pile, and that the shock from a battery so charged could not be distinguished from that of the same battery charged to the same extent from the conductor of a machine ‡. We consider that this alone is strong evidence in favour of the identity of the electricities, although we do not quite agree with Van Marum that it is conclusive.

The effects hitherto obtained from magneto-electricity, the author considers to be, evolution of heat, magnetism, physiological phenomena, the spark. He has not himself effected chemical decomposition by means of it; and he considers that the effects which have been obtained by others do not show true polar decomposition, but are similar to those obtained by Wollaston in the decomposition of water.

That magnetism and physiological phenomena are the only effects which have yet been obtained by means of thermo-electricity, the author attributes to its low degree of intensity.

Mr. Faraday considers that the identity of the electricity of the torpedo with common and voltaic electricity is satisfactorily established, although some effects, attraction and repulsion, due to a state of tension, evolution of heat, and the spark, have not yet been obtained : and in this we fully concur.

The general conclusion which the author draws from the collection of facts which he brings forward, is, that " electricity, whatever may be its source, is identical in its nature ;" and he attributes the difference in the degree to which the phenomena, when originating in different sources, are observed, to the variable circumstances of quantity and intensity. This manner of accounting for the difference in the phenomena due to voltaic and to common electricity was adopted very early in the inquiry, common electricity being considered as ex-

* For this method of ignition we are indebted to Mr. W. Sturgeon. Phil. Mag. 1826.

† Annales de Chimie, 1826, tom. xxxiii. p. 62.

‡ Annales de Chimie, 1802, tom. xl. p. 289.

ceeding in intensity, but deficient in quantity. We however think, that it would be more in accordance with the phenomena to state, that as some effects require continuous action, they can only be obtained from ordinary electricity by rendering the quantity accumulated on a given surface (which quantity is a measure of the intensity,) available as a source of such action.

Although we agree with the author in the conclusions which he draws respecting the identity of electricities, yet there is one point, the mode of their conduction, in which they have been said to differ, on which we wish that he had made some remarks. The current of voltaic electricity runs through the mass of the conducting wire, and its intensity is diminished by increasing the length of that wire; and the same is the case with magneto-electric currents: but common electricity, in a state of tension, resides at or near the surface of a body, and has been considered to be so conducted *; and the shock has been found not to be diminished by the length of the wire through which it takes place. We would however ask, whether it is not a gratuitous assumption to state that electricity is conducted on the surface, because it exists there in a state of tension? That it exists near the surface when in a state of tension, is due to the repulsive force which its particles exert upon each other; and when they are relieved from tension, will not the same repulsive force spread them through the mass of the conducting body? With regard to the shock from a battery not being diminished by the length of the wire through which it takes place, does it not arise from the same quantity of electricity on a given surface being passed, when the equilibrium is restored, between the outside and inside of the battery, whatever may be the length of the conducting wire? We regret that the author's attention was not drawn to this part of the subject; for we feel assured, that had it been so, he would have met the objections which on this ground have been urged against the identity of the electricities. Possibly he was so fully convinced of the futility of these objections, that he considered it unnecessary to notice them.

The second section of this paper details experiments for determining the relation, by measure, of common and voltaic electricity.

The author first determines that the magnetical effect of a given quantity of common electricity from a battery is independent of the surface over which it is spread; and next, that this effect is proportional to the absolute quantity of electricity. The measures by the galvanometer are not professedly very accurate; but it is to be expected that experiments more accurate in this respect, and more varied with regard to the quantity of electricity, would confirm these conclusions. Determining, then, the quantity of voltaic electricity which in a given time will produce the same deflection of the needle as a given quantity of common electricity discharged from a battery, he shows that voltaic electricity of the same intensity will also, in that time, produce the same degree of chemical decomposition which that quantity of common electricity will when passed from the con-

* Phil. Trans. 1832, p. 280.

ductor. Although we are not quite satisfied with this manner of comparing the effects, because we consider that time enters very differently as an element in the several cases, yet we are sensible of the value of the experiments, and think that they strongly confirm the author's conclusions as to the identity of electricities from different sources.

This series of experimental researches in electricity, we consider, makes a very valuable addition to Mr. Faraday's former ones; and we have no hesitation in recommending its publication in the Transactions of the Royal Society.

S. H. Christie.

14th March 1833.

May 9, 1833.

WILLIAM GEORGE MATON, M.D., Vice-President, in the Chair.

A paper was read, entitled, "On the Anatomical and Optical Structure of the Crystalline Lenses of Animals, particularly that of the Cod." By Sir David Brewster, K.H., LL.D., F.R.S. V.P.R.S. Ed.

The author was led, by the observations he had made of some very singular phenomena in the crystalline lenses of fishes and quadrupeds when exposed to polarized light, to examine their minute anatomical structure, with the view of ascertaining if it had any relation to these optical appearances. He found that the crystalline lens of a cod has the form of a prolate spheroid, of which the axis coincides with that of vision. Its body is inclosed in an exceedingly thin and transparent capsule, within which it floats without having any apparent connexion with that capsule, and consists of a hard nucleus surrounded by softer matter. The nucleus is composed of regular transparent laminæ of equal thickness, with perfectly smooth surfaces, presenting the iridescent appearance peculiar to grooved surfaces, and exhibited by mother-of-pearl. These apparent grooves have the direction of meridian lines converging from the equator, where their breadth is greatest, to the two poles, and indicating the boundaries of the component fibres of the laminæ. The author was enabled to trace the course of these fibres to their termination very satisfactorily, when the fibres themselves could not be rendered visible by the best microscopes, by means of the reflected prismatic images of a luminous object, produced by interference. This method furnished also an accurate mode of determining the diameter of the fibres at any point of the spheroid. The uniform distribution of the light refracted through the lamina, as well as the distinctness of the reflected images, prove that these fibres are not cylindrical, but perfectly flat, and gradually tapering in breadth from the equator to the poles of the lens. The thickness of each fibre is at least five times less than its breadth, which, in the most external layer of the equator, is about the 5500th part of an inch.

The observation of another optical phenomenon apparent on looking at a bright light through a thin lamina of the lens of a cod, namely,